Report of the

Executive Seminar

on

Earth Observation for Improving Water Management in Africa

23-25 September 2008
ITC Enschede
The Netherlands
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Summary

Introduction
Water security has become the most important challenge in the sustainable development of Africa. Water managers, policy makers and water users in Africa urgently need reliable information on the use and availability of water in order to adequately plan, manage and predict the changes in water resources. Data acquired from space can contribute to this need. To satisfy the demand for information, good synchronisation is required between water managers, who must indicate their specific information needs, developers of the data gathering-monitoring satellite systems who must what information is needed, and the knowledge institutes that must transfer their knowledge on collection and dissemination to users. During the seminar “Earth Observation for Improving Water Management in Africa: Developing Human, Technical and Institutional Capacity” which was held from 23 to 25 September 2008 at the International Institute for Geo-Information Science and Earth Observation (ITC), Enschede, The Netherlands, scientists, water managers from Africa and experts from knowledge centres had addressed the question: “How can the knowledge available in the area of satellite data use for water management purposes be strengthened in Africa?” The seminar was jointly organized by the Group on Earth Observation (GEO) and ITC’s Department of Water Resources.

The seminar
Many initiatives dealing with earth observation and water management are ongoing in Africa. All these activities require knowledgeable resource persons for their execution and implementation. Recurrent issues in these initiatives are related to the shortage of existing human resources and absorption capacity needed for efficient application of earth observation for improved water management. To further develop human capacity building activities with partners in Africa the seminar addressed three themes:

1. The emerging water resources management issues over the coming years and their information needs;
2. Developments in earth observation based data and information systems and what impact of water resource management decision making processes can be expected;
3. Capacity Building strategies for earth observation and water resources management in and for Africa.

These themes were elaborated by senior experts from African governments, regional and international organizations, capacity building providers, space agencies and policy makers. Emerging water resources management issues and needs were addressed from the perspective of the Nile Basin Initiative, Water Resources Management Authority from Kenya, the Department of Environment of the Democratic Republic Congo and the SADC Secretariat representing the Southern African region. Information on earth observation developments for water resources management, the second theme, was provided by representatives from European and Brazilian space agencies (ESA and INPE), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the Flemish Institute for Technological Development (VITO), Global Energy and Water Cycle Experiment (GEWEX) as well as by the Group on Earth Observation (GEO) and ITC. Capacity building strategies for earth observation and water resources management were presented by knowledge centres from Africa, like the universities and technical institutes from Ethiopia, Ghana and Senegal, regional centres (AGRHYMET from Niamey, Niger and the Regional Centre for Mapping and Resource Development, Nairobi, Kenya), WaterNet (an academic affiliated regional Southern African water education network), supplemented with presentations from UNESCO and ITC. These presentations provided a clear picture of the challenges ahead for capacity building in earth observation for the water management in Africa from different perspectives.
**Outcome of the seminar**

At the end of each theme round table discussions took place and during the final session the representatives from the three thematic groups formulated recommendations to GEO, policy makers, space agencies and funding organizations on capacity building in earth observation for improving water resources management. Recommendations were made related to providing freeware (open source), improving data availability, development and standardization of earth observation-water curriculum for Universities, building upon existing knowledge centres and networks (like WaterNet) to introduce advances in earth observation for water resources management and the need for concrete actions to inform policy makers in a forum such as the African Ministers’ Council on Water (AMCOW). Initiatives such as TIGER, GEONETCast for and by Developing Countries (DevCoCast), the proposed continuation of TIGER and Europe-Africa-Land-Network (EALNet) are excellent ‘vehicles’ through which these recommendations can be implemented in conjunction with the ongoing developments in the framework of GEO related to the construction of the Global Earth Observation System of Systems (GEOSS).

**Dissemination**

Digital copies of the report, all presentations and articles given during the seminar can be downloaded from the ITC website: [http://www.itc.nl/news_events/_data/report_executive_seminar.pdf](http://www.itc.nl/news_events/_data/report_executive_seminar.pdf)

Requests for hardcopies can be addressed to pr@itc.nl.
# List of Abbreviations

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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
<th>Website</th>
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<tbody>
<tr>
<td>AARSE</td>
<td>African Association of Remote Sensing of the Environment</td>
<td><a href="http://www.itc.nl/aarse/">www.itc.nl/aarse/</a></td>
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<tr>
<td>AAU</td>
<td>Addis Ababa University</td>
<td><a href="http://www.aau.et">www.aau.et</a></td>
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<tr>
<td>AMCoW</td>
<td>African Ministers’ Council on Water</td>
<td><a href="http://www.amcow.org/">www.amcow.org/</a></td>
</tr>
<tr>
<td>AMESD</td>
<td>African Monitoring of the Environment for Sustainable Development</td>
<td><a href="http://www.amesd.org/">www.amesd.org/</a></td>
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<tr>
<td>AMU</td>
<td>Arba Minch University</td>
<td><a href="http://www.arbaminch-univ.com/">www.arbaminch-univ.com/</a></td>
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<tr>
<td>ARC</td>
<td>AGRHYMET Regional Center</td>
<td><a href="http://www.agrymet.ne">www.agrymet.ne</a></td>
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<td>AWCI</td>
<td>Asian Water Cycle Initiative</td>
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<tr>
<td>CBERS</td>
<td>Chinese-Brazilian Earth Resources Satellite</td>
<td><a href="http://www.cbers.inpe.br/">www.cbers.inpe.br/</a></td>
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<tr>
<td>CERSGIS</td>
<td>Centre for Remote Sensing and Geographic Information Services</td>
<td>cersgis.org/</td>
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<td>DRC</td>
<td>Democratic Republic of the Congo</td>
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<td>EALNeT</td>
<td>Europe-Africa-Land-Network</td>
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<td>EO</td>
<td>Earth Observation</td>
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<tr>
<td>ESA</td>
<td>European Space Agency</td>
<td><a href="http://www.esa.int/">www.esa.int/</a></td>
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<td>EUMETSAT</td>
<td>European Organisation for the Exploitation of Meteorological Satellites</td>
<td><a href="http://www.eumetsat.int">www.eumetsat.int</a></td>
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<tr>
<td>GEO</td>
<td>Group on Earth Observations</td>
<td><a href="http://www.earthobservations.org/">www.earthobservations.org/</a></td>
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<td>GEOSS</td>
<td>Global Earth Observation System of Systems</td>
<td><a href="http://www.earthobservations.org/">www.earthobservations.org/</a></td>
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<tr>
<td>GEWEX</td>
<td>Global Energy and Water Cycle Experiment</td>
<td><a href="http://www.gewex.org/">www.gewex.org/</a></td>
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<tr>
<td>INPE</td>
<td>Instituto Nacional de Pesquisas Espaciais (National Institute for Space Research)</td>
<td><a href="http://www.inpe.br">www.inpe.br</a></td>
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<tr>
<td>ITC</td>
<td>International Institute for Geo-Information Science and Earth Observation</td>
<td><a href="http://www.itc.nl">www.itc.nl</a></td>
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<tr>
<td>NBI</td>
<td>Nile Basin Initiative</td>
<td><a href="http://www.nilebasin.org">www.nilebasin.org</a></td>
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<tr>
<td>PUMA</td>
<td>Preparation for the use of Meteosat second generation in Africa</td>
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<td>RCMRD</td>
<td>Regional Centre for Mapping of Resources for Development</td>
<td><a href="http://www.rcmrd.org/">www.rcmrd.org/</a></td>
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<tr>
<td>SADC</td>
<td>Southern African Development Community</td>
<td><a href="http://www.sadc.int">www.sadc.int</a></td>
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<tr>
<td>SCADA</td>
<td>Supervisory Control And Data Acquisition</td>
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<tr>
<td>SRTM</td>
<td>Shuttle Radar Topography Mission</td>
<td>www2.jpl.nasa.gov/srtm/</td>
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<tr>
<td>VITO</td>
<td>Vlaamse Instelling voor Technologisch Onderzoek (Flemish Institute for Technology Research)</td>
<td><a href="http://www.vito.be">www.vito.be</a></td>
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<tr>
<td>WHYCOS</td>
<td>World Hydrological Cycle Observing System</td>
<td><a href="http://www.whycos.org">www.whycos.org</a></td>
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<tr>
<td>WRMA</td>
<td>Water Resources Management Authority</td>
<td><a href="http://www.wrma.or.ke">www.wrma.or.ke</a></td>
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Programme

Introduction
Various initiatives dealing with Earth Observation (EO) and water management are ongoing on the African continent such as the European Space Agency’s (ESA) TIGER initiative, Preparation for the use of Meteosat second generation in Africa (PUMA) and the development of a World Hydrological Cycle Observing System (WHYCOS). The African Monitoring of the Environment for Sustainable Development programme (AMESD) was set-up in 2003. The objective of the AMESD programme is to help the African countries to improve the management of their natural resources by providing them with appropriate information on their environment using state-of-the-art technologies, including Earth observation and information and communication technologies. The Group on Earth Observations (GEO) is coordinating international efforts to build a Global Earth Observation System of Systems (GEOSS). This emerging public infrastructure is interconnecting a diverse and growing array of instruments and systems (space, airborne and in-situ) for monitoring and forecasting changes in the global environment.
All these activities require knowledgeable resource persons. Is there sufficient absorption capacity in Africa, and through which mechanisms efficient application of EO can be achieved, are recurrent issues in these initiatives?

The role of ITC in capacity building for earth observation in Africa is widely recognized. Apart from post-graduate degree training at ITC, many capacity building activities are organized with African partners such as: joint (double) diploma courses, tailor-made training refresher courses, and MSc/PhD fieldwork. ITC is also involved in major international networking through platforms such as the African Association of Remote Sensing of the Environment (AARSE) and GEO. Looking ahead for the coming years, challenging opportunities exist to further develop capacity building activities together with partners in Africa and Europe.

ITC, together with GEO, have therefore taken the initiative to organise an executive seminar on this subject on 23-35 September 2008 at ITC in Enschede, The Netherlands. The seminar preceded the official opening of the ITC Academic Year 2008-2009.

Objectives
The seminar had the following objectives:
• Assessment of Earth Observation-related capacity needs of executive organizations;
• Advocate the utilization of earth observation tools and data for water resources management;
• Share information on potential role of Earth Observation in water resources management for organizations in Africa;
• Develop strategies to build Earth Observation capacity within the water sector in Africa.

Set-up of the seminar
The seminar was structured in four working sessions, and focuses on four key questions:
1. What are the emerging water resources management issues in the coming years and what information needs exist?
2. What is currently being developed in EO based data and information systems and what impact on WRM decision making processes can be expected?
3. What is the role of African national and regional knowledge centres in capacity development, and of international institutes like ITC?
4. What are successful delivery modes for improving capacity building: joint degree courses, tailor-made training, distance education, ‘blended’ learning, and on-the-job training?
Outcome
Recommendations to GEO, international capacity building providers, and higher education experts, on short-term priorities on the issue for improving best practices in the domain of EO for water resource management in Africa were formulated. Additional outcome has been the strengthening of the international network (South-South, North-South) of organizations in the field of EO for Water Resources Management and Capacity Building.

The content of the executive seminar
Points of departure for the seminar were the four key questions stipulated above. Discussions around these questions have given insight into which direction providers of capacity building should move to ensure that the right content is delivered in an optimal manner. Water managers were informed on advances in the EO domain, EO specialist were informed on information needs ‘on the ground’ and ‘capacity builders’ were informed on existing training programmes and methods in the field of EO for water resources management.

The format of the seminar
The seminar consisted of three sessions with presentation and short discussions followed by a session where conclusions and recommendations were formulated. The topics were:

- **Theme 1** What are the emerging water resources management issues in the coming years and what information needs exist?
- **Theme 2** What is currently being developed in EO based data and information systems and what impact on WRM decision making processes can be expected?
- **Theme 3** Capacity building strategies for EO and Water in and for Africa.
- **Theme 4** Conclusions and Recommendations.

Each working session consisted of a short introduction by the chairman on the state-of-the-art of the session topic, several presentations by content specialists followed by a discussion. The speeches were given by invited professionals of national and international organisations involved in water resources management, basin organizations, earth observation system development and applications, and faculty heads and directors of knowledge centres (see appendix 1 for full list of participants). Finally, participants reflected on questions pertinent to the session topic in a workshop format.
Presentation schedule and titles

TUESDAY 23 SEPTEMBER 2008

14:00  ITC Directorate: Drs. Sjaak Beerens - Director External Affairs ITC
       Opening of the Executive Seminar

14:10  Ir. Arno van Lieshout, Chairman Organizing Committee ITC
       Structure of Seminar

Theme 1: What are the emerging water resources management issues in the
coming years and what information needs exist

14:15  Chair: Dr. Chris Mannaerts, ITC, The Netherlands.
       Introduction

14:15  Dr. Canisius Kanangire, ATP, Regional Project Manager, Nile Basin
       Initiative (NBI), Egypt.
       Keynote: Water Resources Management Issues and Challenges in the
               Nile Basin.

14:45  Eng. Philip Olum, Water Resources Management Authority (WRMA),
       Kenya.
       Water Resources Issues and Interventions in Kenya.

15:15 – 15:30  Coffee / tea break

15:30  Eng. Christmas Maheri, Southern African Development Council
       (SADC), SADC Secretariat, Botswana.
       SADC Water Resources Management Issues over the coming years
       and the existing information needs.

16:00  Mr. Crispin Sedeke Okwul, Department of Water Resources, DR
       Congo
       Problems related to Durable Management of the Water Resources of
       the Basin of Congo, Prospect and Existing Information Needs.

16:30  Discussion

18:00  Icebreaker

WEDNESDAY 24 SEPTEMBER 2008

Theme 2: What is currently being developed in EO based data and information
systems and what impact on WRM decision making processes can be expected

09:00  Chair: Prof. Z. Bob Su, ITC, The Netherlands.
       Introduction

09:05  Dr. Diego Fernandez, European Space Agency (ESA), Italy.
       Keynote: The Tiger Initiative. Supporting African Efforts towards an
               African Water Observation System.
09:25 Dr. Ben Maathuis, Assistant Professor Department Water Resources ITC, The Netherlands. 
*ITC GEONETCast Toolbox Approach.*

09:50 Dr. Douglas Cripe – Water and Agriculture Expert, GEO, Switzerland. 
*GEOSS and Africa: Earth Observation in Support of Decision Making.*

10:10 Dr. Volker Gärtner - Head of User Service Division, European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), Germany. 
*EUMETSAT’s Systems in Support of Earth Observation.*

10:30 Coffee break

11:00 Dr. Gilberto Câmara – General Director, Instituto National de Pesquisas Espaciais (INPE), Brazil. 
*Geospatial Data for Africa: The Brazilian Contribution*

11:20 Dr. Lieven Bydekerke, Flemish Institute for Technology Research (VITO), Belgium. 
*Remote Sensing Applications & Services in Africa: Some cases.*

11:40 Dr. Peter van Oevelen – Director Global Energy and Water Cycle Experiment (GEWEX), USA. 
*Application of Water and Energy Cycle Science and Observations within the Framework of GEWEX.*

12:00 Discussion

12:30 Lunch

**Theme 3: Capacity building strategies for EO and Water in and for Africa**

Introduction

13:50 Prof. Z. Bob Su, ITC, The Netherlands 
Keynote: *TIGER or DRAGON: Capacity building in Earth Observation of Water Resources System as a backbone for informed Water Resource Management.*

14:10 Dr. Themba Gumbo, WaterNet, Botswana 
Keynote: *Up-scaling human and institutional capacity in integrated water resource management: Opportunities from new knowledge technologies.*

14:35 Dr. Nigussie Teklie Girma, Arba Minch University, (AMU), Ethiopia 
*Arba Minch University: Achievements and Challenges in its Effort towards Capacity Building in Various Fields of Water Technology.*
15:05  Dr. Foster Mensah, Centre for Remote Sensing and Geographic Information Services (CERSGIS), Ghana
Capacity Building strategies for EO and Water Management in Africa.

15:25  Dr. Atnafu, Addis Ababa University (AAU), Ethiopia
Outline on Capacity Building of the Department of Earth Sciences (AAU) in water-related academic and scientific activities.

15:40  Coffee / tea break

16:00  Dr. Souleye Wade, Cheikh Anta Diop University, Senegal
Capacity Building strategies in Earth Observation applications for Sustainable Development in Africa: achievements and prospects.

16:20  Dr. Justin Ahanhanzo, UNESCO, France
UNESCO-IOC, Africa in the big Picture.

16:40  Discussion

THURSDAY 25 SEPTEMBER 2008

Theme 3: Capacity building strategies for EO and Water in and for Africa (continued)

09:00  Chair: Dr. Peter van Oevelen, GEWEX, USA

09:05  Dr. Hussein Farah, Director Regional Centre for Mapping of Resources for Development (RCMRD) Kenya
Keynote: Regional Centre for Mapping of Resources for Development: Its Role in Eastern and Southern Africa Sub-Region

09:30  Dr. Abdou Ali, Hydrologist AGRHYMET, Niger
Keynote: Water Resources Management and Capacity Building at AGRHYMET.

Theme 4: Conclusions and recommendations

10:00  Preparation outcome workshop sessions in 3 groups

11:10  Coffee / tea break

11:30  Reporting themes by rapporteurs

12:00  Round table discussion

12:30  Closing remarks: Dr. P. van Oevelen, Prof. Alfred Stein (deputy rector, ITC) and A. van Lieshout

13:00  Lunch

15:00  Opening Academic Year ITC 2008 - 2009
Report of the sessions

Opening

Opening by Drs. S. Beerens, Director External Affairs / ITC
The executive seminar is opened by Drs. Beerens on behalf of ITC and GEO (Group on Earth Observation)

Mr. Beerens gives an introduction of ITC as institute (founding and mission) and explains the development of ITC’s mission into cross-border activities. ITC started to support organizations through capacity building, initially in the framework of overseas development assistance, but is increasingly developing into joint educational activities. A brief overview is presented of ITC's experiences with capacity building (related to the policy and ITC’s missions, but also on issues related to management, quality control and accreditation).

Mr. Arno van Lieshout
The Chairman of the organizing committee briefly explains the set-up of the seminar, the rationale and the expected outcomes. Goals and objectives of the seminar and the expected output are presented.

Theme 1: What are the emerging water resources management issues in the coming years and what information needs exist

Chair: Chris Mannaerts - ITC, The Netherlands
Rapporteur: Robert Becht - ITC, The Netherlands
Date: Tuesday 23 September
Time: 14:00 – 17:30

Presentations:

In his keynote Dr. Canisius Kanangire (NBI, Egypt) described that the capacity to generate knowledge for the benefit of Africa remains low and capacity to absorb advances in technology is limited. Increasing the existing capacity is hampered by lack of human resources (aggregated by the brain-drain), lack of funds and lack of data. The sharing of these limiting resources to increase its efficiency remains problematic. The main causes for this are political, institutional, national considerations not focused on really creating an enabling environment fostering win-win situations and equal partnerships. This should change and we have to move to a system focusing on the sharing of benefits. Increase benefits from the river, decrease cost caused by the river, increase benefits beyond the river, and increase benefits to the river.

Eng. Philip Olum, (WRMA, Kenya) gave a presentation on the water sector reforms implemented in the last 5 years in Kenya. The Ministry of Water has a limited but high level capacity and mainly deals with policy development. The implementation is now carried out by a new set of institutions such as the Water Resources Management Authority and the Water Services Regulatory Boards. Devolution of power to the lowest levels and participatory processes play a key role in the reforms. Reforming a sector does not solve all problems at once so Kenya is still facing problems similar to the ones identified by the previous speaker from the NBI: limited resources in terms of humans, capital and data.
Eng. Christmas Maheri (SADC, Botswana) gave an overview of the vision and mission of the South African Development Community with 16 member states. The SADC vision is one of a common future, a future in a regional community that will ensure economic well-being, improvement of the standards of living and quality of life, freedom and social justice and peace and security for the people of Southern Africa. This shared vision is anchored on the common values and principles and the historical and cultural affinities that exist between the people of Southern Africa. A common vision for water and environment is politically endorsed and based on IWRM and resources sharing. Common database is in place but the authority to access data is still with the individual member states.

Mr. Crispin Sedeke Okwul (Department of Water Resources, DR Congo) gave an overview of the very large Congo basin: 10 riparian countries, the surface area is 4 million sq km, after the Amazon the second largest river in the world with an average discharge of 40,000 m$^3$s$^{-1}$? Until recent water was not considered an important issue and this combined with the political instability of the basin has caused that all aspects of water and environmental management are in their infancy: the list of limiting factors is very long and it is a challenge to take this up and assist the DRC and other riparian countries in the basins. Clearly more data on water resources is needed.
Theme 2: What is currently being developed in EO based data and information systems and what impact on WRM decision making processes can be expected?

Chair: Prof. Z. Bob Su – ITC, The Netherlands
Rapporteur: Prof. Wouter Verhoef – ITC, The Netherlands
Date: Wednesday 24 September
Time: 09:00 – 12:30

Presentations:

In his keynote Dr. Diego Fernandez (ESA, Italy) reported on the great progress made in the TIGER programme, launched on 2006, towards capacity building and the important question how to retrieve information from satellite images. A large part of the capacity building component took place at ITC. Several results of activities were shown, such as the SCADA-network to couple satellite data to ground observations for calibration purposes. For water management, water quality and soil moisture are important products as inputs for decision making. Adaptation to climate change was also an important issue addressed his talk. A lot has been achieved but challenges to connect with the end user still remain. A launch of TIGER2 is envisaged in 2009.

Dr. Ben Maathuis (ITC, The Netherlands) presented his keynote on the significant achievements of GeoNetCast, which is aimed at an effective dissemination, easy access to data and products, and low-cost reception and processing of satellite data/products. An impressive range of products, including animated time series, were demonstrated. The importance of free and open source software like ILWIS 3.5 and free availability of data were also stressed in this keynote. Current efforts are directed at the facilitation of data access by African Academic Centres.

Dr. Douglas Cripe (GEO, Switzerland) presented the GEO philosophy and the ‘global earth observation system of systems’ (GEOSS) initiative. He referred to important applications like monitoring of droughts, floods as input for water resources management, capacity building, and the generation of integrated products. A dedicated geostationary satellite called ‘GEO Africa’ which would cover entire Africa at high resolutions (20 meters, 11 spectral channels, revisiting every 4 days) is currently proposed. The development of GEO portals to stimulate web-based applications was shown, as well as the set-up of the GEO website, where a lot of useful information and satellite products can be obtained. Finally he stressed the importance of forming a Community of Practice, where domain knowledge is shared amongst community members.

Dr. Volker Gärtner (EUMETSAT, Germany) presented the various meteorological and geo-biophysical products disseminated by his organisation and collaborating (European) meteorological agencies. Many new products from polar orbiting satellite are currently under development/pre-operational stage. EUMETCast/GEONECTCast facilitates access to a great number of products. A product navigator is available to assist the user to find his way to the product he needs on the web. Distance learning and two-way communication were presented as new ways to realise capacity building, still giving room for traditional teaching by a tutor in a classroom, since it was found that pure distance learning often does not work. The formation of a ‘joint resource library’ was presented as another means to facilitate the access to shared information.

1 Check the document below to read the GEO Capacity Building Strategy as Accepted at GEO-III (Nov. 2006) http://www.earthobservations.org/documents/committees/cbc/capacity_building_strategy.pdf
Dr. Gilberto Câmara (INPE, Brazil) presented the impressive achievements made in the joint development with China of the constellation of the Chinese-Brazilian Earth Resources Satellite(s) (CBERS). Brazil and China announced at the fourth GEO meeting (November 2007) that they are to distribute free images from CBERS to African countries. This constellation will provide free remote sensing data from a range of platforms and sensors with different spatial resolutions at a high temporal frequency. The long-term programme has been planned until 2020. The distribution of CBERS images to Africa will be possible due to the use of receiving stations located in South Africa, Kenya (where the station belongs to Italy), the Canary Islands and Italy. Distribution will be carried out by means of the GEONetCast system, created by the GEO, as well as through other channels on the internet. One more receiving station in West-Africa (most likely in Nigeria) needs to be established. He stressed the importance of a free data policy to stimulate the use of moderate to high resolution data, and easy access to the data via a user-friendly web-based user interface, which was also demonstrated by him online. Another product distributed by INPE is a global 30 m. DEM derived from processed 90 m. SRTM data, which can be used to model water availability. He also stressed a free and open source software policy.

Dr. Lieven Bydekerke of VITO in Belgium introduced his organisation, which is active in the processing of SPOT-VGT data into a number of mostly vegetation-related products. Small water bodies (and time series of them) are a new product to be used for water resources management. Normalized Difference Water Index (NDWI) is an index of plant leaf water to be used in applications related to water stress and drought. Many of the products can be shown as animated time series. Dr. Bydekerke addressed the distribution of the data in 4 different ways, the partnerships with other organisations, and the aspect of training and capacity building. Through VGT4Africa VITO distributes processed SPOT-VEGETATION data and derived indicators in partnership with EUMETSAT to all meteorological departments in Africa. The VGT@WORK programme focuses on strengthening capacity at the Botswana Meteorological Service and AGRHYMET through exchange of experts and on site training. Capacity building and training is inherent to many of the projects executed and a significant effort is put on training sessions mostly oriented towards the use of low resolution imagery for monitoring purposes.

Dr. Peter van Oevelen of GEWEX (Global Energy and Water Experiment, USA), presented the long history of scientific research executed under this initiative. This research is focused mainly at global issues like the global energy budget and the global water cycle. Historic data archives are subject to ageing, and re-processing of the data is necessary to preserve them for use by later generations. Especially for climate change research these historic data are becoming more and more important. The steps from global to regional scale products, and from these to the end user (water management) are hard to make. Accessibility and availability of data are keywords to remove the bottlenecks. Currently GEWEX data are used to predict monsoons and extreme events to stimulate greater involvement of end users. There is clear need to incorporate data from Africa monitoring sites to improve model performance.
Theme 3: Capacity building strategies for EO and Water in and for Africa

Chair: ir Joep Houterman – Netherlands Organisation for International Cooperation in Higher Education (NUFFIC), The Netherlands
Rapporteur: Dr Zoltan Vekerdy – ITC, The Netherlands
Date: Wednesday 24 September - Thursday 25 September 2008
Time: 13:45 – 18:00, 09:00-10:00

A total of 7 presentations were given on capacity building strategies and initiatives.

Presentations:

Prof. Bob Su, ITC, started from the global issues related to water resources and outlined how the Water Resources Department of ITC addresses the related capacity building challenges. Physical-based EO methods are of primary importance. He provided two examples: the Dragon project focusing on China and other Asian countries, then the TIGER Capacity Building Facility which supports the EO activities in the water sector in Africa. These activities are in line with the goals of GEO. A dedicated water observation initiative in Africa is considered as an essential infrastructure to strengthen the research and application capabilities in earth observation for water resources management in the longer-term in Africa. European and other funding agencies are challenged to take this opportunity.

Dr. Themba Gumbo, WaterNet, pointed out the gap between the water management information needs and the data collection facilities in Africa. WaterNet has its own capacity building programme: Masters in IWRM with 200 graduates and 15 PhDs, 30 short courses and collaborative research in cooperation with African universities. Through a yearly IWRM-symposium and publications, findings are disseminated in Southern Africa. Dr. Gumbo requested ITC to provide scientific back-stopping to education and training of WaterNet; to assist in human and institutional capacity strengthening for the SADC-region and jointly with universities of the WaterNet ‘family’ develop and to submit research proposals.

Dr. Nigussie Teklie Girma, Arba Minch University (AMU), explained the capacity building activities in his institute. Shortage of staff, high staff turnover, brain drain and limited infrastructure are problems for many universities in Africa. AMU started in 1986 as the Water Technology Institute and got the university status in 2004. AMU provides education at certificate, degree, diploma and Masters level. AMU has good contacts with water authorities and city councils. The government policy on education is aiming at a distribution of 70% engineering and science and 30% social science graduates.

Dr. Foster Mensah, (CERSGIS/University of Ghana) explained capacity building strategies at his university in the following fields: environmental challenges related to water; water scarcity; continuous assessment and monitoring; EO for spatial datasets; Land use change on water resources; degradations and protection of river sources. He underlined the need for developing and strengthening capacity building networks; sensitise decision makers to support initiatives related to Geo Information and EO.

Dr. Atnafu, Faculty of Earth Sciences, Addis Ababa University, introduced his institute. They have graduate programme since 1978. The largest enrolment is in GIS, RS and hydrogeology. They plan to launch a PhD programme in the coming 5 years (hydrogeology, geophysics and structural geology). GIS and RS are tools. The university hosts the National Isotope Hydrology lab. International cooperation started with Italian researchers. The university has regional cooperation with Djibouti and Kenya. In partnership with ITC, AAU provides teachings in postgraduate courses at RCMRD, Kenya. Further needs for
development are training courses in RS, GIS and Photogrammetry for MSc and PhD students and staff of other streams. Satellite receiving station such as GEONETCAST is needed. EO data is needed for research purposes.

**Dr. Hussein Farah**, director RCMRD (Kenya) gave an overview of the African Regional Centres and more specifically the RCMRD. The centre was founded in 1975 under the auspices of the United Nations Economic Commission for Africa. It is an intergovernmental organization and currently has 15 contracting member States mainly in Eastern and Southern Africa. The operations of the Centre are funded in part by contributions from contracting member States and revenue generated from sales of its products and services. The mission of the centre is to promote the development and use of geoinformation for sustainable development of Africa. The Centre is involved in the promotion of the development of National Spatial Data Infrastructure (NSDI). RCMRDs’ task is to promote the development of geo-spatial data and information in the region and strengthening the capacity of the member States in the use of geo-spatial information in sustainable development, and, in collaboration with others undertake research and training. RCMRD is also participating in the SERVIR programme through which satellite observations and predictive models are integrated with sensor and field-based information. A web-based system is under development to monitor and forecast ecological changes and respond to natural disasters. Through SERVIR, users and existing databases and portals are connected. Currently it has a nucleus of 30 professionals, which is enhanced, by a group of retained associates in specialized fields.

**Dr. Abdou Ali**, The AGRHYMET Regional Center (ARC), is a technical agency of Permanent Interstate Committee for Drought Control in the Sahel. Nine west-African countries are members. It was created in 1974 and has its headquarters in Niamey, Niger. Its mandate is “to contribute to sustainable food security, management of natural resources and environment in the Sahel by strengthening the capacity of national institutions, producing and disseminating information for decision makers and users”. It includes data management, applied research, dissemination of information on regional food security and early warning but also training and transfer of tools and methods to national components. The areas covered are climatology, agro-meteorology, hydrology, plant protection and remote sensing. In addition to ground-based observation data, ARC uses remote sensing data (mainly METEOSAT and SPOT-Vegetation) to develop indicators for environmental monitoring issues in the region. ARC is also a training institution that has successfully conducted training at Higher Technician and Engineering levels since 1975 in crop protection, agricultural meteorology, hydrology, instrumentation and microcomputer maintenance. ARC has initiated a Master’s degree program on Concerted Management of Natural resources including water management.

Dr. Ali expressed that action in the field of reinforcement of technical capacity of regional centres, creation of a pool of regional EO experts, the development of EO-based products on evapotranspiration, soil moisture are required. Also investments should be made to strengthen the water resources monitoring systems and Early Warning capabilities in the region given the high inter-annual hydrological variability. In combination with EO based systems the national hydrological in-situ data collection should be improved.

**Dr Souleye Wade**, Cheikh Anta Diop University, Senegal spoke about capacity building strategies in EO applications for sustainable development. He pointed out that effective use of EO requires sustained investment. Capacity building has three levels: human, institutional and social levels. So far, in Africa, there is not enough (no critical mass of) skilled persons. UN ECA (Economic Commission for Africa) established 5 regional RS centres in Africa. Hundreds of people have been trained to get basic skills. Additionally, the centres are the focal points of technology transfer. Several courses, e.g. UNOOSA – training courses, seminars and capacity building in RS, etc. These centres promote international cooperation. Recommendation: new UN centre is needed in West (Francophone) Africa.
Then he listed several organizations, initiatives and networks, e.g. USAID (national budget by African governments for Geo-Information, institutionalize Capacity Building, improve infrastructure for data acquisition and analysis, etc.); CEOS Working Group on Education, Tiger Capacity Building Facility (selected research centres); PUMA contributions to CB; AMESD African monitoring of environment for sustainable development. GMES Africa is the next step to link African countries to the GEO process. He also stresses the importance of EIS Africa: a non-profit organization dealing with data policy, facilitating national programmes, sharing best practices etc.

Finally, Dr. Souleye concluded that EO and GI remain rudimentary in Africa and there is a lack of multiplicative effect. He recommended put emphasis on 1.) networking at all levels and cooperations; 2.) networking of networks and 3.) networking for building capacity.

Dr Justin Ahanhanzo, UNESCO outlined capacity building strategies for EO and water in Africa. He started with three remarks:
1. There is already some capacity, so you do not only build but empower.
2. The most important questions are: Why do we build the capacity? If it is part of the national plan, than we should understand the national needs, etc. for the capacities. How do we take into account the role of universities in the national strategies? What are the regional opportunities and perspectives? What are the national agreements/frameworks?
3. Based on the above any capacity should be built on the national strategies and frameworks.

In 2002 a cross-cutting project was started in UNESCO in the Division of Water. UNESCO supported the first workshop on EO for sustainable development in last year. An advisory board was set up. Then, he listed some further UNESCO efforts and other initiatives. The guiding framework is the vision on an African Union. The initiatives are: NEPAD Action Plan, WSSD Implementation plan, the MDGs.

Key elements are:
- empower the existing institutions and infrastructure to access and use EO data
- reinforce dedicated teaching and education centres, the universities
- Fostering of regional, international, East-West and North-South cooperation
- Development of joint and complementary activities
- Fostering outreach and public awareness
- Complete and integrated observation and forecasting system
- Empowerment of institutional and human resources
- International cooperation
- A list of networks and institutions.

He concluded that we have to shift the paradigm: from capacity building to building on capacity.
Report Executive Seminar 23-25 September 2008

Theme 4 Conclusions and Recommendations

Chair: Dr. Peter van Oevelen - GEWEX
Rapporteur: Arno van Lieshout - ITC
Friday: 25 September 2008
Time: 10:00 – 13:00

Time was allocated for discussion and formulation of conclusions and recommendations for each theme. The reports from the three themes are summarized followed by overarching conclusions and recommendations.

Theme 1: Water resource management information needs

The following observations are made:

1. Persistent on the water agenda is the lack of data and information. To make informed decisions on issues such as water demand and supply to various sectors, floods & droughts early warning, climate change adaptation strategies, easy access to reliable data is a prerequisite. Water information could be easier analyzed and addressed if such data were available.

2. Better indicators are needed to monitor the Water & Sanitation situation to substantiate effect of measures. Water sector reform takes place in many countries transforming the traditional water ministries and creating many new institutions like Water Management Authorities (national), Water users associations (local) and supra-national basin authorities (NBI etc). To address water management at these various time and space scales require a complex flow of information between various institutional settings. There is a clear need for water information systems on various scales that can manage such complex information needs. Information should be easy accessible to various stakeholders covering the same magnitude of scales. A two way scaling system from Water Resources User Association (WRUAs) level scale to national and vice versa for effective flow of information should be given consideration to ensure timely response to emerging issues.

3. Funding agencies should realize that capacity building programmes take much longer than standard 3-4 years project cycle.

Theme 2: Advances in EO for water resource management

Many advances are taken place. EO data at various temporal and spatial scales is becoming more and more available through web-services and locally established receiving stations. However there is a big challenge to scale the available data down to applicable information for local water resources. The capacity to absorb and apply EO-based data 'on the ground' in Africa should be enhanced. The following recommendations (mainly directed to GEO) are made:

4. Increase data accessibility and availability. Focus on regional centres which can perform information services such as AGRHYMET and RCMRD. Space agencies should make data easily available free of charge or at nominal costs.

5. Encourage participation from countries and international organizations in the GEO process.
6. Institutional Centres with regional mandate (SADC, AGRHYMET) should be encouraged to use GEONETCast to broadcast EO-data. GEO should outreach the current capabilities to as many entities as possible.

7. The role of academic institutions to produce graduates well prepared for EO applications in water resources management needs to be strengthened. Through applied research programmes, universities could positively influence water resources related policies and decision making.

8. GEO should emphasis the importance of existing universities which could absorb new technology in the field of application of EO data. Universities should play a role in quality control (and research) over current and newly developed products. Continuous validation is needed with respect to GEONETCast.

9. There is need to develop an African Water Cycle Initiative (similar as the TIGER programme, but with a clear focus on Water Cycle) with local organizations with a regional mandates as major players. Links should be made and synergy created with similar initiatives such as the Asian Water Cycle Initiative\(^2\) (AWCI).

10. Establishing calibration and validation sites in Africa, similar to what AWCI has done for Asia. River discharge data has to be made available. Universities and regional centres should receive assistance in the development and maintenance of hydrological monitoring stations.

11. GEO has a pivotal role to play in getting water resources related data accessible and coordinate the establishment of ground-based measurements stations. GEO should promote through its portals free data access, and provide a structure such that data from monitoring stations can be used free of charge.

**Theme 3: Capacity building strategies**

Universities and Regional centres both play a role in providing a sustainable human resources base in the field of EO for water resource management. Universities have a clearly different mandate than regional centres. Both cater for different clients and hence do provide a different type of training (degree level training versus tailor-made training).

The following recommendations are made:

12. Build on the existing capacity within universities and regional centres. Regional centres can serve as nodes of EO data providers, catering for different disciplines.

13. Cooperation between ‘southern’ institutions should be promoted through network arrangements, joint development of curriculum and the promotion of joint/double degree training and credit transfer arrangements. For better interoperability and for setting clear performance indicators, it is important to work out standard settings, accreditation and certification procedures for education in the field of EO and water resource management. With proven standards, course credit transfer between institutions could be realized relatively easy.

14. Facilities should be made available for the upgrading of infrastructure needed for EO training. The high cost of software licences and essential investments in hardware should

not be the limiting factor for curriculum development. Use of, and development in open source software should be promoted.

15. Easy and fast access to internet is still a bottle neck in Africa. Universities and regional centres should make additional investments to get sufficient internet bandwidth. With sufficient bandwidth, advanced distance/E-learning modules could be offered with support from international institutes.

16. Water-related institutions (stakeholders) should be involved in identifying capacity building requirements, give directions for the research agenda and provide (logistical, data and financial) support to study real world cases.

17. For maintaining capacity, research oriented centres/institutes could be developed ‘around’ the universities and regional centres for keeping the trained people in the countries and in the knowledge field.

18. Universities should promote and be able to do applied research. For fundamental oriented research a link with Department of Physics is an interesting option. Joint research with CGIARs\(^3\) and others should be promoted.

19. Research results and effect of training-programmes should be made known to the public and decision makers.

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\(^3\) Check [www.cgiar.org/impact/challenge/cccpx.html](http://www.cgiar.org/impact/challenge/cccpx.html) for details on the Climate Change, Agriculture and Food Security Challenge Program of the Consultative Group on International Agriculture Research.
Strategic directions for ITC role in EO for WRM in Africa

The seminar, combined with ongoing capacity building activities in Africa, are important contributions for the WRS department to develop action lines for the future. ITCs’ role should be a neutral broker and leader in subject matter and partner in research and joint courses. The WRS department should focus on the development of curricula linking EO and WRM and applied research in this field with universities and regional centres/networks.

1. Joint educational programmes in ‘EO for WRM’ in various formats, ranging from short certificate courses, ‘summer schools’ to full MSc degree courses, should be established with strong internationally recognized universities.

2. Team-up with established educational networks like WaterNet as an instrument for delivery of various courses and execute joint research. As a follow-up of the seminar collaboration with WaterNet should be formalized.

3. Promote scientific backing for investments in building capacity in ‘EO supported Water Resource Management’. Presentations for the technical advisory committee of AMCoW and at conferences such as African Water Week⁴ and World Water Week⁵’s could be good platforms for ‘EO for Water Resource Management’ promotion.

4. Increase accessibility and availability of data on the ground in Africa through participation in EU financed projects and promoting water information systems at funding organization level. Reference is made to GEONETCast for and by Developing Countries (DevCoCast), ILWIS 3.5 (open-source GIS-EO software) and INPE’s-free data policy.

5. Providing access to data is not the ‘final’ solution, there is a need for application oriented data and integration of the data in common WRM practices (‘penetration in practice’). Case studies where the above is demonstrated should be identified and supported. Congo basin could be a case at the basin level, Water Resources Users Association in Kenya at the local level.

6. ITCs’ participation in programmes such as TIGER and Europe-Africa-Land-Network (EALNet) should get a high priority. These programmes are excellent ‘vehicles’ through which the recommendations made in the seminar can be implemented in conjunction with the ongoing developments related to the construction of the Global Earth Observation System of Systems (GEOSS)–programme.

7. Research is an important engine to enforce capacity. Through fundamental research the way for development of EO-applications in water resources management is paved. ITC should promote research in the closure of water cycle and develop advanced level curriculum from research output.

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⁴UNEP, UN-HABITAT and UNESCO have accepted to host the Second African Water Week 2009/10 which will take place in Nairobi, Kenya.

⁵The 2009 World Water Week will be held from August 16-22 in Stockholm. The theme for 2009 will be “Accessing Water for the Common Good”, see http://www.worldwaterweek.org .
List of participants

Mr Durk Adema
Ministry of Foreign Affairs
Den Haag
The Netherlands
E-mail: dg.adema@minbuza.nl

Dr Justin Ahanhanzo
water resources Africa
UNESCO
Paris
France
E-mail: J.Ahanhanzo@unesco.org

Dr Balemwal Atnafu Alemu
Head of dept.
Addis Ababa University
Addis Ababa
Ethiopia
E-mail: balem@geol.aau.edu.et
balemwal@yahoo.com

Dr Abdou Ali
hydrology expert
Centre Regional Agrhymet
Niamey
Niger
E-mail: a.ali@agrhymet.ne

Drs Robert Becht
Asst. Prof. Dept. of Water Resources
ITC
Enschede
The Netherlands
E-mail: becht@itc.nl

Drs Sjaak Beerens
Director External Affairs
ITC
Enschede
The Netherlands
E-mail: beerens@itc.nl

Ir. Bert Boer
Senior Project Officer Bureau Marketing
and Project Services
ITC
Enschede
The Netherlands
E-mail: boer@itc.nl

Ir Lieven Bydekerke
Projecten Manager Remote Sensing
VITO
MOL
Belgium
E-mail: lieven.bydekerke@vito.be

Dr Gilberto Câmara
Director General
INPE
São José dos Campos
Brazil
E-mail: gilberto.camara@inpe.br

Dr Douglas Cripe
GEO
Genève
Switzerland
E-mail: dcripe@geosec.org

Dr Hussein Omar Farah
Director General
RCMRD
Nairobi
Kenya
E-mail: farah@rcmrd.org

Dr Diego Fernandez
Tiger
ESA/ESRIN
Frascati
Italy
E-mail: Diego.Fernandez@esa.int

Dr Volker Gärtner
Strategy and Int Rel Off
EUMETSAT
Darmstadt
Germany
E-mail:
Regina.Hoefenmayer@eumetsat.int

Dr.-Ing. Nigussie Teklie Girma
Vice President for Business &
Development
Arba Minch University
Arba Minch
Ethiopia
E-mail: nigussie_tg@yahoo.com
Dr Themba Gumbo
WaterNet Manager
Harare
Zimbabwe
E-mail: bgumbo@waternetonline.org

Eng. Christmas Maheri
SADC Secretariat
Gaborone
Botswana
E-mail: cmaheri@sadc.int

Mr Joep Houterman
Directeur Capaciteitsopbouw en Beurzen
Nuffic
Den Haag
The Netherlands
E-mail: jhouterman@nuffic.nl

Dr Chris Mannaerts
Assoc. Prof. Dept. of Water Resources
ITC
Enschede
The Netherlands
E-mail: mannaerts@itc.nl

Prof. Graham Jewitt
University of Kwazulu Natal
Scottsville
South Africa
E-mail: jewittg@ukzn.ac.za

Prof. Martien Molenaar
Rector
ITC
Enschede
The Netherlands
E-mail: molenaar@itc.nl

Dr. Canisius Kanangire
Regional Project Manager Applied Training Programme
Nile Basin Initiative
Cairo
Egypt
E-mail: ckanangire@nilebasin.org

Dr Foster Mensah
Executive Director
CERSGIS/University of Ghana
Legon, Accra
Ghana
E-mail: fmensah@ug.edu.gh

Dr. Peter Oevelen
Director
International GEWEX Project Office
Silver Spring
USA
E-mail: peter.vanoevelen@gewex.org

Eng. Philip Olum
CEO WRMA Kenya
Nairobi
Kenya
E-mail: japheth.onyando@gtz-wsrp.or.ke

Prof. Dr. Japheth Onyando
IWRM specialist, Egerton University
Egerton University
Njoro
Kenya
E-mail: jonyando@yahoo.com
japheth.onyando@gtz-wsrp.or.ke

Dr Ben Maathuis
Asst. Prof. Dept. of Water Resources
ITC
Enschede
The Netherlands
E-mail: maathuis@itc.nl

Drs Ipo Ritsema
Deltares
Utrecht
The Netherlands
E-mail: ipo.ritsema@deltares.nl
Mr Crispin Sedeke Okwul  
Ministry of Environment  
Kinshasa  
Congo  
E-mail: crisedeke@yahoo.fr

Prof. Z. Bob Su  
Professor of Spatial Hydrology and Water Resources Management  
ITC  
Enschede  
The Netherlands  
E-mail: b_su@itc.nl

Drs Ineke ten Dam  
Education Specialist  
ITC  
Enschede  
The Netherlands  
E-mail: tendam@itc.nl

Dr Paul van Dijk  
Director Graduate Programme  
ITC  
Enschede  
The Netherlands  
E-mail: vandijk@itc.nl

Ir. Arno van Lieshout  
Course Director Water Resources and Environmental Management (WREM)  
ITC  
Enschede  
The Netherlands  
E-mail: lieshout@itc.nl

Dr Zoltan Vekerdy  
Asst. Prof. Dept. of Water Resources  
ITC  
Enschede  
The Netherlands  
E-mail: vekerdy@itc.nl

Prof. Wouter Verhoef  
Visiting Professor of Advanced Earth Observation for Water Resources Applications  
ITC  
Enschede  
The Netherlands  
E-mail: verhoef@itc.nl

Prof. Souléye Wade  
Cheikh Anta Diop University  
Dakar-Fann  
Senegal  
E-mail: wadesouleye@yahoo.fr

Ms Anke Walet  
Management Assistant  
Dept. of Water Resources  
ITC  
Enschede  
The Netherlands  
E-mail: walet@itc.nl

Dr Tsehaie Woldai  
Assoc. Prof. Dept. of Earth Systems Analysis  
ITC  
Enschede  
The Netherlands  
E-mail: woldai@itc.nl